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NATIONAL DAM SAFETY PROGRAM CUMBERLAND POND DAM, (NJ00824). DEL--ETC(U)
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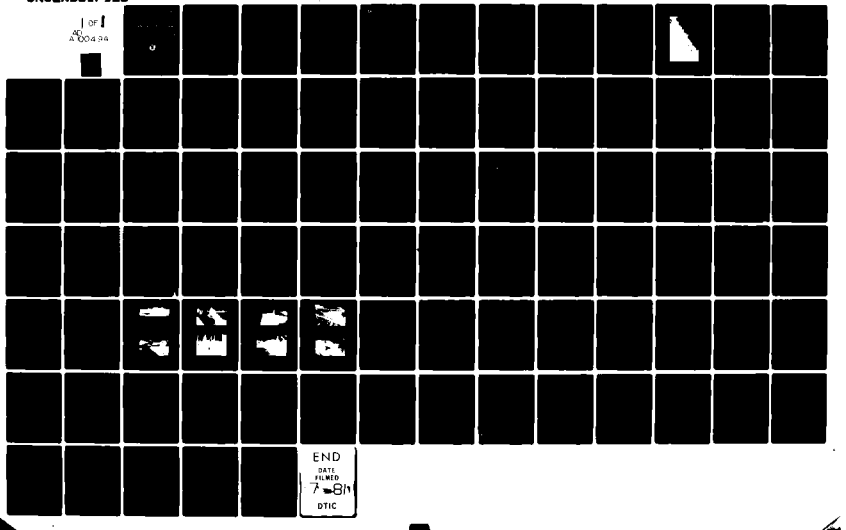

LEVEL II

DELAWARE RIVER BASIN
MANUMUSKIN RIVER
CUMBERLAND COUNTY
NEW JERSEY

CUMBERLAND POND DAM

NJ00824

Dick / Milbourn
John / Gribbon

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Cumberland Pond Dam (NJ00824). Delaware River Basin, Manumuskin River, Cumberland County, New Jersey. Phase I Inspection Report.

Final rpt.

DACW61-79-C-0011

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

JUNE 1981

410 891

REPT. NO. DAEN/NAP-53842/NJ00824-81/06

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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Dams
Embankments
Visual Inspection
Structural Analysis
National Dam Safety Program
Cumberland Pond Dam, N.J.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

29 MAY 1981

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Cumberland Pond Dam in Cumberland County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Cumberland Pond Dam, a high hazard potential structure, is judged to be in good overall condition. The dam's spillway is considered inadequate because a flow equivalent to 53 percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood). The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within six months from the date of approval of this report, the following remedial actions should be initiated:

(1) Eroded areas on the upstream face of the embankment and adjacent to the bridge should be properly stabilized.

(2) All trees and adverse vegetation on the embankment should be removed.

c. The owner of the dam should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Hughes of the Second District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

Kenneth R. Moser

KENNETH R. MOSER
Major, Corps of Engineers
Acting District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

CUMBERLAND POND DAM (NJ00824)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 8 January 1981 by Storch Engineers, under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Cumberland Pond Dam, a high hazard potential structure, is judged to be in good overall condition. The dam's spillway is considered inadequate because a flow equivalent to 53 percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood). The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within six months from the date of approval of this report, the following remedial actions should be initiated:

(1) Eroded areas on the upstream face of the embankment and adjacent to the bridge should be properly stabilized.

(2) All trees and adverse vegetation on the embankment should be removed.

c. The owner of the dam should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

APPROVED: Kenneth R. Moser

KENNETH R. MOSER
Major, Corps of Engineers
Acting District Engineer

DATE: 29 May 1981

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Cumberland Pond Dam, I.D. NJ00824
State Located:	New Jersey
County Located:	Cumberland
Drainage Basin:	Delaware River
Stream:	Manumuskin River
Date of Inspection:	January 8, 1981

Assessment of General Condition of Dam

Based on visual inspection, past operational performance and Phase I engineering analyses, Cumberland Pond Dam is assessed as being in good overall condition.

Hydraulic and hydrologic analyses indicate that the spillway is inadequate. Discharge capacity of the spillway is not sufficient to pass the designated spillway design flood (SDF) without an overtopping of the dam. (The SDF of Cumberland Pond Dam is equal to one-half the probable maximum flood.) The spillway is capable of passing approximately 26 percent of the probable maximum flood or 52 percent of the SDF. Therefore, the owner should engage a professional engineer experienced in the design and construction of dams in the near future to perform more accurate hydraulic and hydrologic analyses relating to spillway capacity. Based on the findings of the analyses, the need for and type of remedial measures should be determined and then implemented.

The owner should, in the near future, develop an emergency action plan together with an effective warning system outlining actions to be taken by the operator to minimize downstream effects of an emergency at the dam.

In addition, it is recommended that the following remedial measures be undertaken by the owner in the near future.

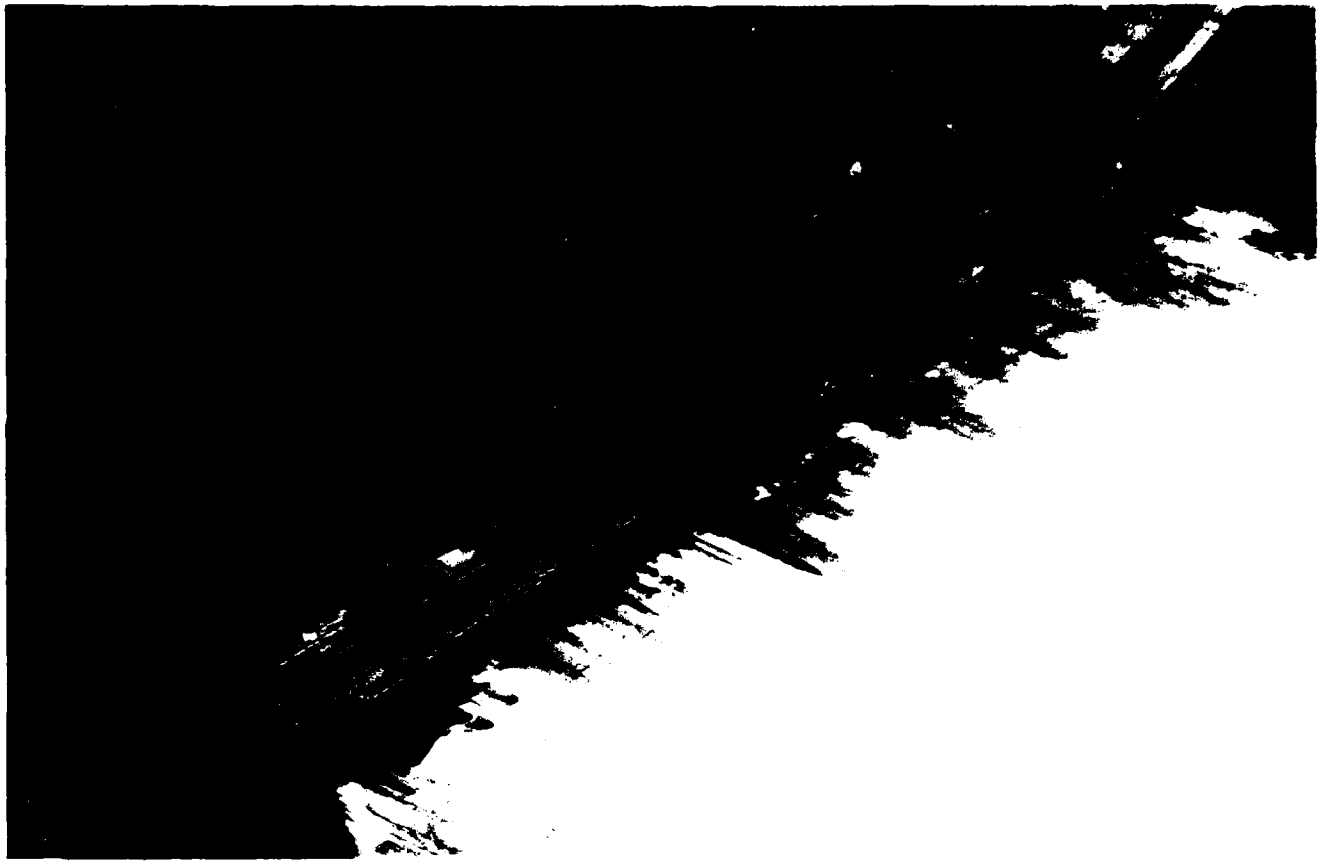
1) Eroded areas on of the upstream face of the embankment and adjacent to the bridge should be properly stabilized.

2) All trees and adverse vegetation on the embankment should be removed.

In the future, the owner of the dam should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

Richard J. McDermott, P.E.

John E. Gribbin, P.E.



OVERVIEW - CUMBERLAND POND DAM

31 JANUARY 1981

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that the unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydraulic and hydrologic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydraulic and hydrologic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

CUMBERLAND POND, I.D. NJ00824

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The Division of Water Resources of the New Jersey Department of Environmental Protection (NJDEP) in cooperation with the Philadelphia District of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the State of New Jersey. Storch Engineers has been retained by the NJDEP to inspect and report on a selected group of these dams. The NJDEP is under agreement with the Philadelphia District of the Corps of Engineers.

b. Purpose of Inspection

The visual inspection of Cumberland Pond Dam was made on January 8, 1981. The purpose of the inspection was to make a general assessment of the structural integrity and operational adequacy of the dam structure and its appurtenances.

1.2 Description of Project

a. Description

The dam is an earth embankment supporting the roadway of N.J. Highway Route 49. A timber stoplog spillway is located at the upstream end of a concrete bridge near the left end of the dam. The outlet works is formed by the stoplogs which comprise the spillway.

The upstream and downstream faces of the dam are stabilized by grass, bushes and trees.

The elevation of the spillway crest is 28.5, National Geodetic Vertical Datum (N.G.V.D.) while that of the crest of dam is 34.7. The elevation of the invert of the downstream channel is 22.5 while that of the discharge channel (concrete bridge) bed is 26.0. The overall length of the dam is 840 feet and its height is 12 feet.

b. Location

Cumberland Pond Dam is located in Maurice River Township, Cumberland County, New Jersey. Principal access to the dam is by Route 49 which traverses the crest of the dam. Discharge from the spillway of the dam flows into the Manumuskin River.

c. Size and Hazard Classification

The dam is classified in accordance with criteria presented in "Recommended Guidelines for Safety Inspection of Dams" published by the U.S. Army Corps of Engineers. Size categories consist of Small, Intermediate and Large while hazard categories are designated as Low, Significant and High.

Size Classification: Cumberland Pond Dam is classified as "Small" size since its maximum storage volume is 663 acre-feet (which is less than 1000 acre-feet) and its height is 12 feet (which is less than 40 feet).

Hazard Classification: Visual inspection of the downstream flood plain of the dam together with breach analysis indicate that failure of the dam would damage the roadway of NJ Route 49 which traverses the crest of the dam. It is also anticipated that dam failure during a storm equivalent to the SDF would cause inundation of four dwellings located between 100 feet and 600 feet downstream from the dam and may cause loss of life. Accordingly, Cumberland Pond Dam is classified as "High" hazard.

d. Ownership

Cumberland Pond Dam is owned by the New Jersey Department of Transportation, 1035 Parkway Avenue, Trenton, N.J. 08625. The impoundment, Cumberland Pond, is owned by the Meadowood Rod & Gun Club, P.O. Box 845, Millville, N.J. 08330.

e. Purpose of Dam

The purpose of the dam is the impoundment of a private recreational lake facility.

f. Design and Construction History

Reportedly, the present spillway structure was constructed in 1929 when the New Jersey State Highway Department replaced the downstream bridge culvert. Plans on file with the NJDOT Bridge Division entitled "Route No. 47, Sec. 2, Sta. 256+41," dated 5/7/29 reflect the as-built conditions.

g. Normal Operational Procedures

The dam and appurtenances are maintained by the New Jersey Department of Transportation, Maintenance Division. There is no fixed schedule of maintenance; repairs are made as the need arises.

The outlet works (removal of the stoplogs) is used to drain the lake for lake maintenance purposes, usually on request from the owner of the impoundment. It is not known when the lake was last lowered.

1.3 Pertinent Data

a. Drainage Area	27.9 square miles
b. Discharge at Damsite	
Maximum flood at damsite	Unknown
Outlet Works at pool elevation	58 cfs.
Spillway capacity at top of dam	896 cfs
c. Elevation (N.G.V.D.)	
Top of Dam	34.7
Maximum pool-design surcharge	35.2
Recreation pool	29.0
Spillway crest	28.5
Stream bed at centerline of dam	25.7
Maximum tailwater	29 (Estimated)
d. Reservoir	
Length of maximum pool	2800 feet (Estimated)
Length of recreation pool	1800 feet (Scaled)

e. Storage (Acre-feet)

Recreation pool	57 acre-feet
Design surcharge	770 acre-feet
Top of dam	663 acre-feet

f. Reservoir Surface (acres)

Top of dam	230 acres (Estimated)
Maximum pool - design surcharge	245 acres (Estimated)
Recreation pool	26.3 acres

g. Dam

Type	Earthfill
Length	840 feet
Height	12 feet
Sideslopes - Upstream	2 horiz. to 1 vert.
- Downstream	3 horiz. to 1 vert.
Zoning	Unknown
Impervious core	Unknown
Cutoff	Unknown
Grout curtain	Unknown

h. Diversion and Regulating Tunnel — N.A.

i. Spillway

Type	Sharp Crested Timber Weir
Length of weir	17.5 feet
Crest elevation	28.5
Gates	Timber Stoplogs Form Principal Spillway
Upstream channel	N.A.
Discharge channel	Concrete Bridge

j. Regulating Outlet

Timber stoplogs, 17.5 feet long, fitted in spillway structure

SECTION 2: ENGINEERING DATA

2.1 Design

No plans or calculations pertaining to the original construction of the dam could be obtained. Drawings prepared in 1929 are on file with the NJDOT, Bridge Division which show plans of the present spillway and appurtenant structures.

2.2 Construction

No data or reports pertaining to the original construction of the dam embankment are available.

2.3 Operation

Reportedly, informal maintenance reports are on file with the NJDOT Maintenance Division pertaining to the spillway but does not include the embankment.

2.4 Evaluation

a. Availability

Available engineering data is limited to that which is on file with the NJDOT. The file contains a plan showing the spillway structure constructed in 1929.

b. Adequacy

Available engineering data pertaining to Cumberland Pond Dam is adequate to be of limited assistance to the performance of a Phase I evaluation. A list of absent information is included in paragraph 7.1.b.

c. Validity

Data relating to the dam embankment could not be found on file with the NJDOT. The validity of engineering data cannot be assessed due to the absence of data.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

The inspection of Cumberland Pond Dam was performed on January 8, 1981 by staff members of Storch Engineers. A copy of the visual inspection check list is contained in Appendix 1. The following procedures were employed for the inspection:

1) The embankment of the dam, appurtenant structures and adjacent areas were examined.
2) The embankment and accessible appurtenant structures were measured and key elevations determined by surveyor's level.
3) The embankment, appurtenant structures and adjacent areas were photographed.
4) The downstream flood plain was toured to evaluate downstream development and restricting structures.

b. Dam

The pavement on the crest of dam (Route 49) appeared to be in satisfactory condition. In addition, a guide rail consisting of timber posts and cables extended along the upstream face of the crest of dam and appeared to be in satisfactory condition.

The downstream face of dam was covered with grass, bushes and trees with sizes ranging from 2 inches to 18 inches in diameter. The upstream face of dam was also covered with grass, bushes and trees approximately 2 inches in diameter. The upstream face appeared to be fairly uniform. However, there was some erosion observed along the upstream face, especially one erosion gully located about 15 feet left of the spillway which

appeared to be due to surface runoff. There was also some erosion evident on each side of the spillway on the upstream side of the dam. One additional area of erosion was located approximately 40 feet to the right of the spillway on the upstream side. This was a fairly large gully near the right end of dam which appeared to be due to surface runoff and pedestrian activity.

c. Appurtenant Structures

The concrete surfaces of the wingwalls and headwalls of the bridge on the downstream side appeared to be satisfactory. Along the water line the concrete surface appeared to be slightly eroded, with some aggregate exposed. Also a vertical crack was observed in the left wingwall which appeared to have been patched. The concrete forming the headwall and wingwalls and training walls on the upstream side all appeared to be in generally satisfactory condition with exposed aggregate noted along the waterline.

The spillway crest consisted of two spans of timber stoplogs. The discharge obscured the stoplogs so that a proper evaluation of their condition could not be made. However, the entire structure appeared, in general, to be sound. There was a timber brace spanning between the center upright grooved timber and the upstream headwall of the bridge. It appeared to be generally sound.

A graduated staff gage was observed in the stilling basin adjacent to the right downstream wingwall. It was graduated in hundredths of a foot and water level at the time of inspection was at 2.80 feet.

d. Reservoir Area

The impoundment of the dam is 1800 feet long with a width varying from 100 to 1000 feet. It is completely surrounded by a forested area with one building located near the upstream end of the reservoir. Its shore slopes appear to be flat with banks about 2 feet high.

e. Downstream Channel

The spillway discharges into a stilling basin which is lined with trees. The terrain adjacent to the basin is fairly flat with a grade of 2 to 3 percent. The discharge then continues into the Manumuskin River which is a sluggish meandering stream with home sites located on the left bank. The banks are approximately 2 feet high with a gentle sloping flood plain of approximately 2 percent.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The level of water in Cumberland Pond is regulated by discharge over the timber stoplogs. At present the outlet works (timber stoplogs) of the dam can be used to drain the lake or to augment the discharge capacity of the spillway.

Reportedly, the NJDOT regulated the spillway stoplogs until 1972 when spillway maintenance and operation activity was discontinued.

It is not known when the lake was last drawn down.

4.2 Maintenance of the Dam

Reportedly, maintenance is performed on an "as needed" basis. The NJDOT Maintenance Department maintains the shoulder of the roadway on the crest of the dam embankment and reportedly does not maintain the upstream or downstream sides of the dam as a result of budget reductions.

4.3 Maintenance of Operating Facilities

It is not known when the lake was last drawn down. Also, it is not known when maintenance of the stoplogs was last performed. Operation of the stoplogs was discontinued in 1972.

4.4. Descrption of Warning System

Reportedly, no warning system is currently in use for the dam.

4.5 Evaluation of Operational Adequacy

The operation of the dam has not been successful to the extent that the dam reportedly was overtopped in 1976. No other occurrences of overtopping are known.

Although maintenance has been good in some areas, a few aspects of dam maintenance have not been adequately performed, including the following:

1) Eroded areas on the upstream face of the dam and adjacent to the bridge not properly stabilized.
2) Trees on the embankment not removed.
3) Eroded concrete surfaces on the bridge wingwalls not repaired.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

The quantity of storm water runoff that the spillway should be able to handle is based on the size and hazard classification of the dam. This runoff quantity, called the spillway design flood (SDF) is described in terms of return frequency or probable maximum flood (PMF) depending on the extent of the dam's size and potential hazard. According to the "Recommended Gudielines for Safety Inspection of Dams" published by the U.S. Army Corps of Engineers, the SDF for Cumberland Pond Dam falls in a range of 1/2 PMF to PMF. In this case, the lower end of the range, 1/2 PMF, is chosen since the factors used to select size and hazard classification are on the low side of their respective ranges.

The SDF peak computed for Cumberland Pond Dam is 1899 c.f.s. This value is derived from the PMF flood hydrograph computed by the use of the HEC-1-DAM Flood Hydrograph Computer Program using Snyder's snythetic unit hydrograph method. Hydrologic computations and computer output are contained in Appendix 4.

The spillway discharge rates were computed by the use of a weir formula appropriate for the configuration of the spillway structure. The total spillway discharge with lake level equal to the top of the dam was computed to be 896 c.f.s. The SDF was routed through the dam by use of the HEC-1-DAM computer program using the modified Puls Method. In routing the SDF, it was found that the dam crest would be overtopped by a depth of 0.6 feet.

A dam breach analysis was then performed using a trapezoidal breach section with bottom length of 100 feet and sideslopes of 1 horizontal to 1 vertical. The breach peak outflow was computed to be 6245 c.f.s. Dam breach computations are contained in Appendix 4.

The breach analysis indicates that dam failure from over topping would cause inundation of the four dwellings located between approximately 100 and 600 feet downstream from the dam. Also, a breach of the dam would damage the roadway of N.J. Route 49 located on the crest.

The analysis indicated that failure of the dam would not significantly increase the hazard to loss of life downstream over that which would exist without failure. Accordingly, the subject spillway is assessed as being inadequate in accordance with criteria developed by the U.S. Army Corps of Engineers.

b. Experience Data

Reportedly, the dam was overtopped in 1976. Reportedly, as a result of the overtopping, a portion of the highway was damaged but no significant property damage was sustained downstream.

c. Visual Observation

No evidence was found at the time of inspection that would indicate that the dam had been overtopped.

d. Overtopping Potential

As indicated in paragraph 5.1.a. a storm of magnitude equal to the SDF would cause overtopping of the dam by a depth of 0.6 foot over the crest of the dam. The spillway is capable of passing approximately 26 percent of the PMF or 52 percent of the SDF with the lake level equal to the top of dam.

e. Drawdown Data

Drawdown of the lake is accomplished by removing stoplogs. Total time for drawdown is estimated to be approximately 17 hours. (See Appendix 4.)

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The dam appeared, at the time of inspection to be outwardly structurally sound with no evidence of embankment cracks or distress. The vertical crack that was observed in the center of the left wingwall does not appear to be an indication of distress in the spillway structure or the embankment.

b. Generalized Soils Description

The generalized soils description of the site consists of recent alluvium deposited along most of the stream courses. The material, composed predominantly of silt and sand intermingled with organic matter, is poorly drained and in a swampy condition. Underlying the alluvial deposits is loose, uniform sand and silty sand with some gravel, referred to on the Geologic Map of New Jersey as the Cape May Formation. Depth to bedrock is greater than 100 feet.

c. Design and Construction Data

Analysis of structural stability and construction data for the embankment are not available.

d. Operating Records

No operating records are available for the dam. The water level of Cumberland Pond is not monitored.

e. Post-Construction Changes

Reportedly, it is not known whether or not there have been any post-construction changes to the dam or area around the dam. No evidence of significant post-construction changes was noted at the time of inspection.

f. Seismic Stability

Cumberland Pond Dam is located in Seismic Zone 1 as defined in "Recommended Guidelines for Safety Inspection of Dams" which is a zone of very low seismic activity. Experience indicates that dams in Seismic Zone 1 will have adequate stability under seismic loading conditions if they have adequate stability under static loading conditions. Cumberland Pond Dam appeared to be stable under static loading conditions at the time of inspection.

SECTION 7: ASSESSMENT AND RECOMMENDATIONS

7.1 Dam Assessment

a. Safety

Based on hydraulic and hydrologic analyses outlined in Section 5 and Appendix 4, the spillway of Cumberland Pond Dam is assessed as being inadequate. The spillway is not able to pass the SDF without an overtopping of the dam.

The embankment appeared, at the time of inspection, to be generally outwardly stable. The crack observed in the center of the left wingwall was not considered to be evidence of dam instability.

b. Adequacy of Information

Information sources for this report include 1) field inspections, 2) USGS quadrangle, 3)consultation with personnel of Misco Chemical Company and 4) consultation with personnel and information on file with the NJDOT. The information obtained is sufficient to allow a Phase I assessment as outlined in "Recommended Guidelines for Safety Inspection of Dams."

Some of the absent data are as follows:

1. Description of fill material for embankment.
2. Design computations and reports.
3. Soils report for the site.

c. Necessity for Additional Data/Evaluation

Although some data pertaining to Cumberland Pond Dam are not available, additional data are not considered imperative for this Phase I evaluation.

7.2 Recommendations

a. Remedial Measures

Based on hydraulic and hydrologic analyses outlined in paragraph 5.1.a, the spillway is considered to be inadequate. It is therefore recommended that a professional engineer experienced in the design and construction of dams be engaged in the near future to perform more accurate hydraulic and hydrologic analyses relating to spillway capacity. Based on the findings of these analyses, the need for and type of remedial measures should be determined and then implemented.

The owner should, in the near future, develop an emergency action plan together with an effective warning system outlining actions to be taken by the operator to minimize downstream effects of an emergency at the dam.

In addition, it is recommended that the following remedial measures be undertaken by the owner in the near future.

1) Eroded areas on the upstream face of the embankment and adjacent to the bridge should be properly stabilized.
2) All trees and adverse vegetation on the embankment should be removed.

b. Maintenance

In the future, the owner of the dam should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

PLATES

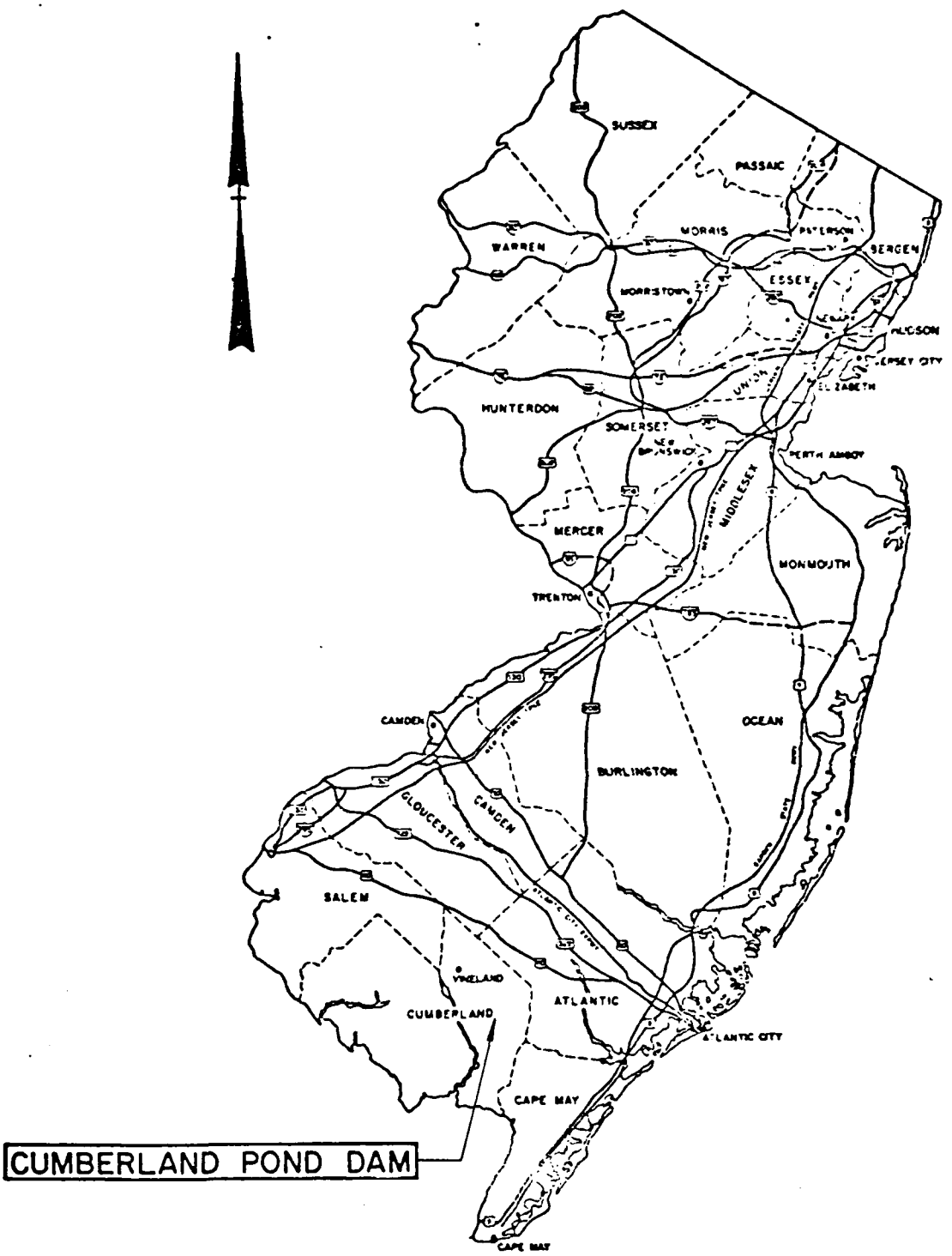
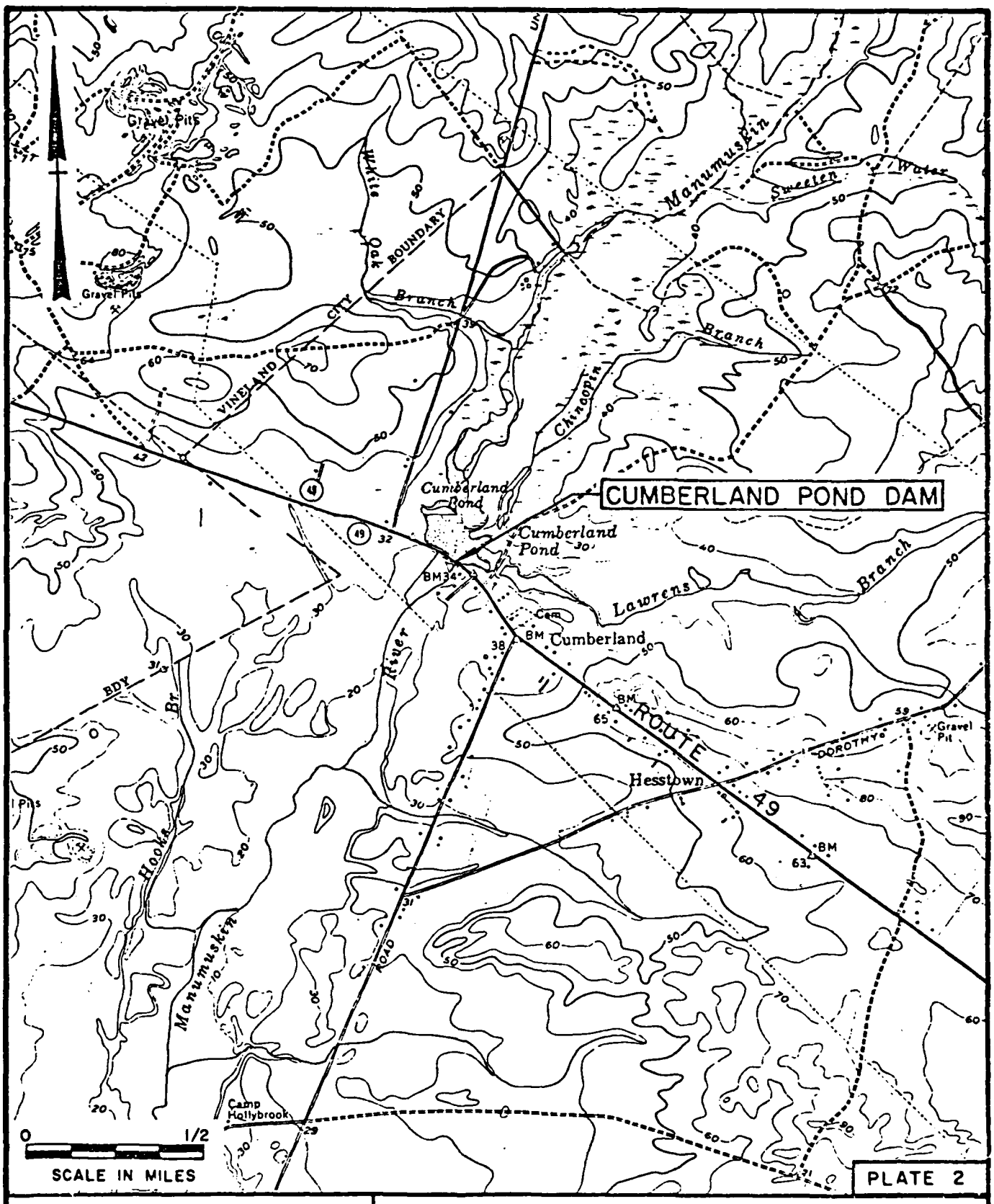


PLATE 1

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS KEY MAP CUMBERLAND POND DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	SCALE: NONE DATE: FEB. 1981



STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

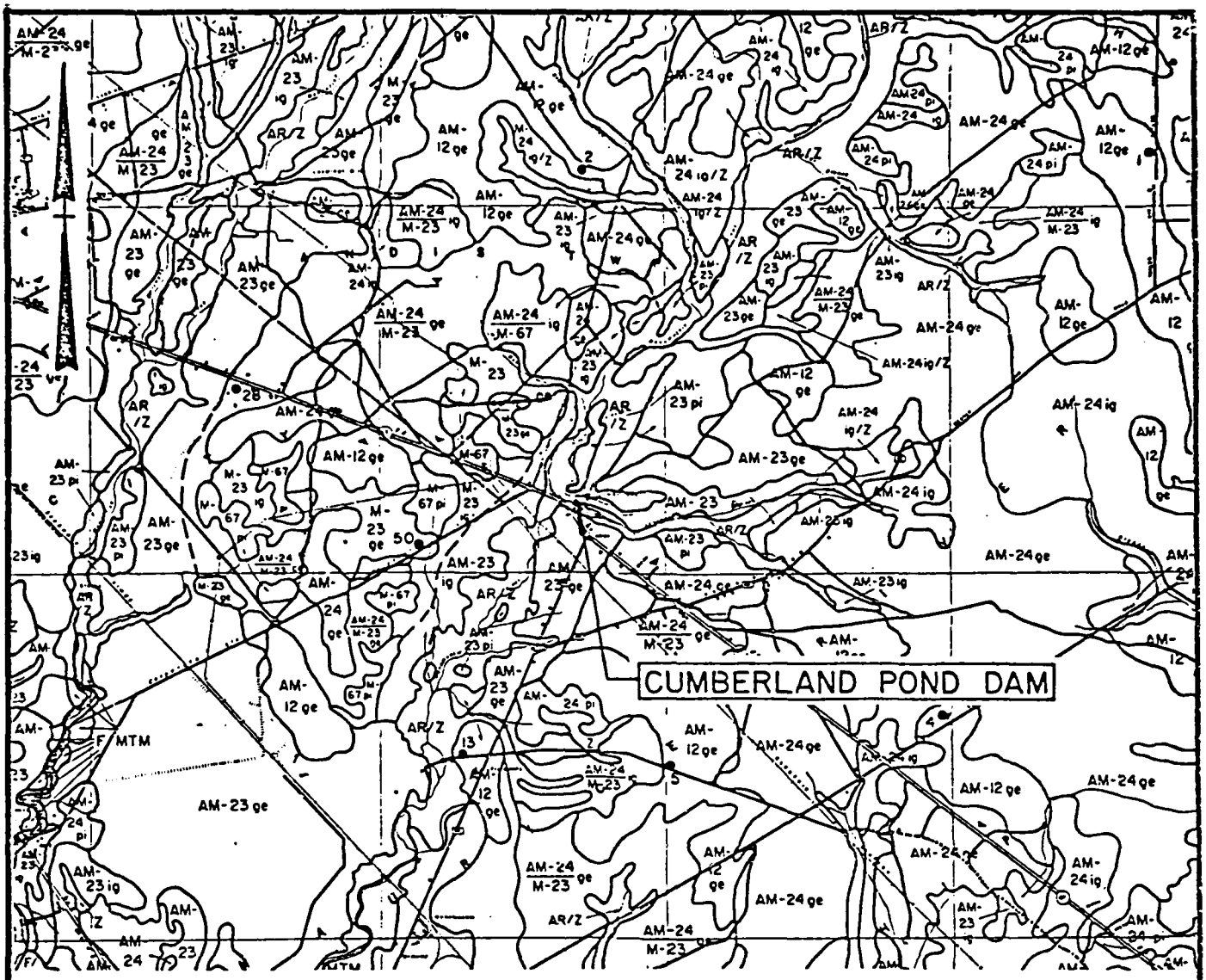
DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

VICINITY MAP

CUMBERLAND POND DAM

SCALE: AS SHOWN
DATE: FEB. 1981



Legend

AR/Z — Recent alluvial deposits in a poorly drained, swampy condition.

AM-23 — Irregular mantle of stratified material referred to on the Geologic Map of New Jersey as the Cape May formation.

Note: Information taken from Rutgers University, Soil Survey of New Jersey, Report No. 21, Cumberland County, June 1955 and Geologic Map of New Jersey prepared by J.V. Lewis and H. Kummel 1910-1912, revised by H. B. Kummel 1931 and M. Johnson 1950.

PLATE 3

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY.

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY.

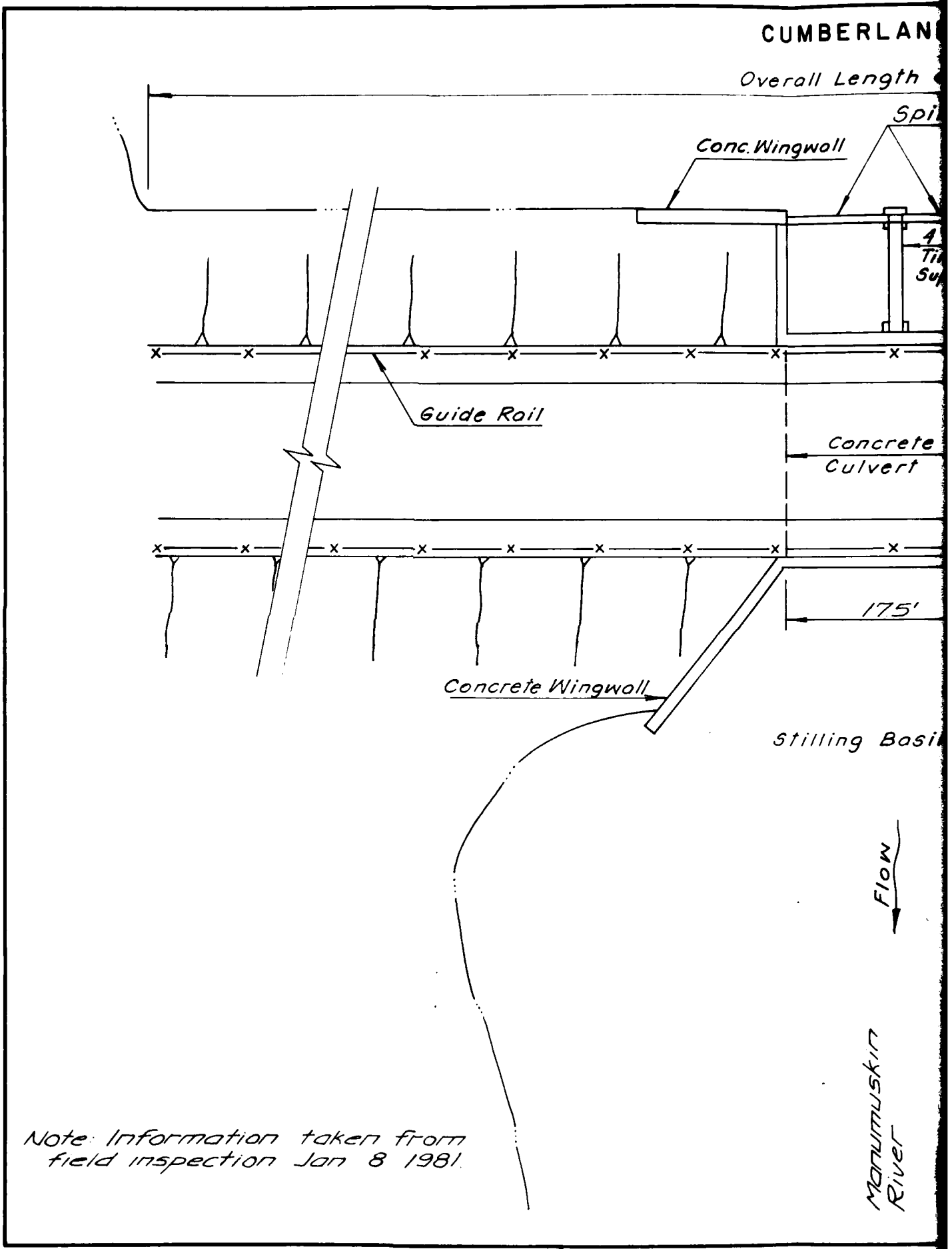
INSPECTION AND EVALUATION OF DAMS

SOIL MAP

CUMBERLAND POND DAM

SCALE: NONE

DATE: FEB.1981


CUMBERLAN
Overall Length
Spi
Conc. Wingwall
4
Ti
Su
Guide Rail
Concrete
Culvert
175'
Concrete Wingwall
Stilling Basi
Flow
Manumuskin
River
Note: Information taken from
field inspection Jan 8 1981

LAND POND

gth of Dam = 840'

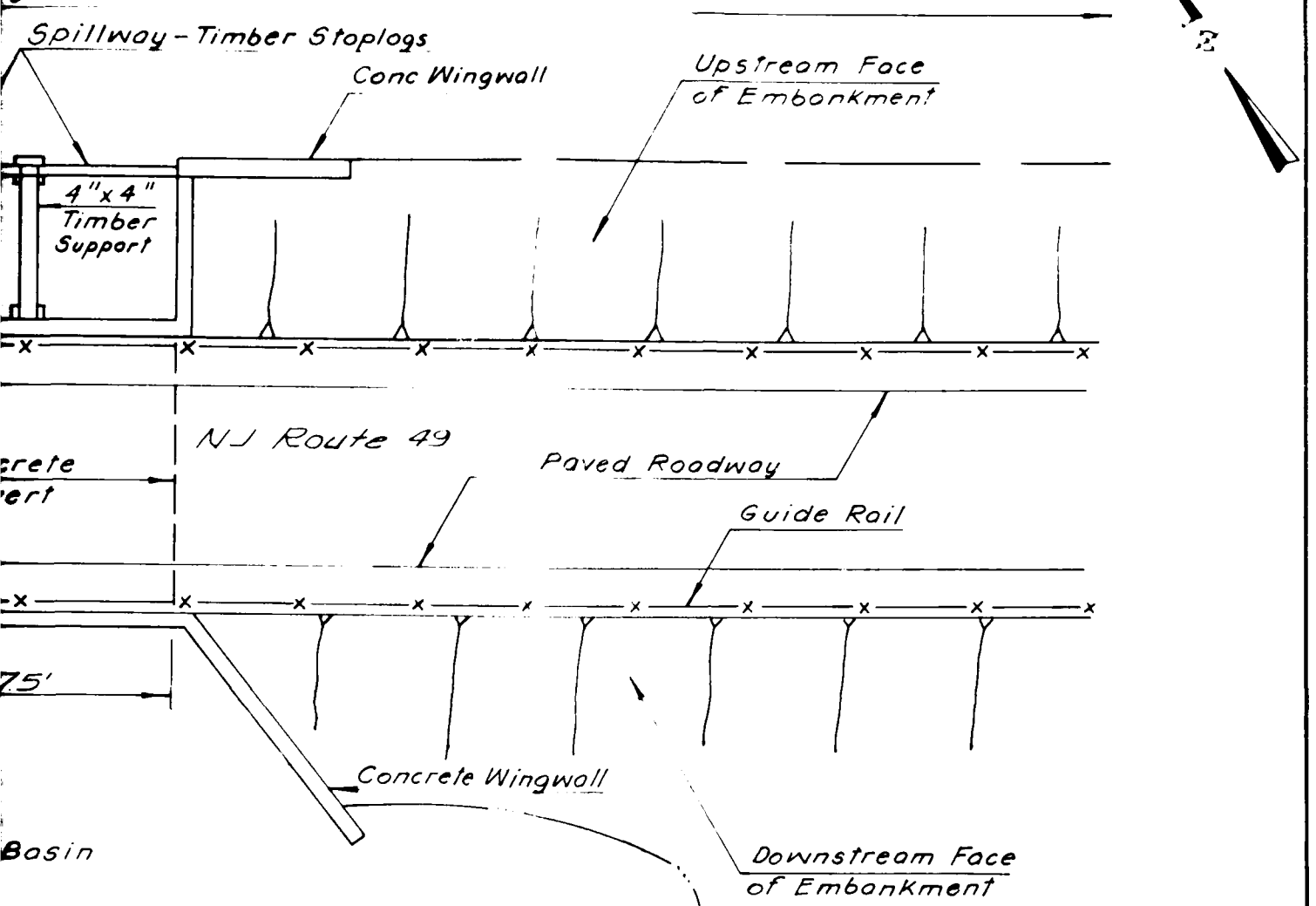


PLATE 4

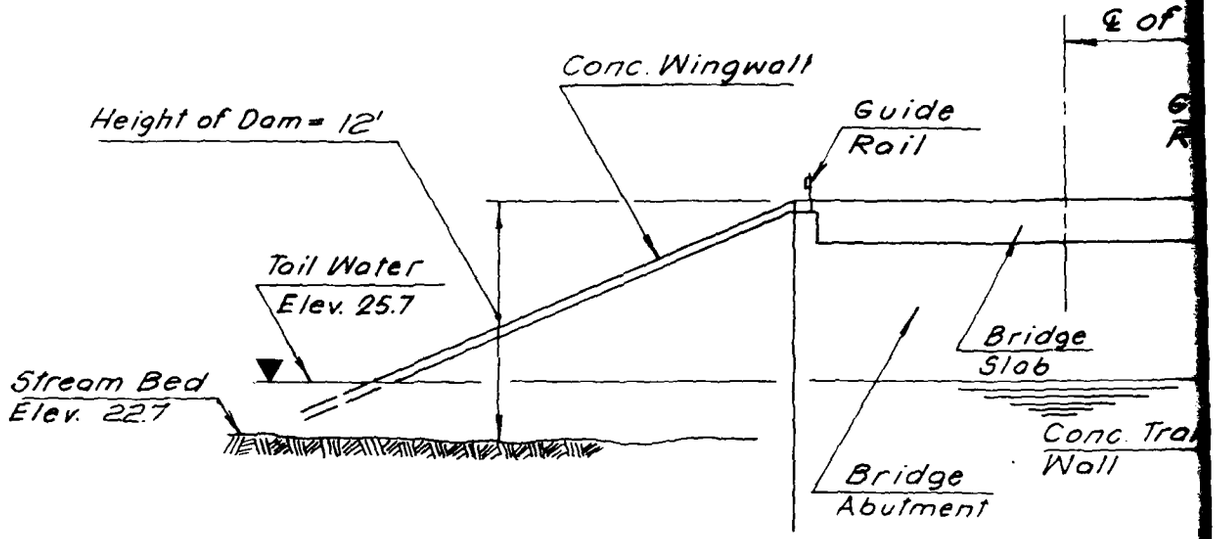
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

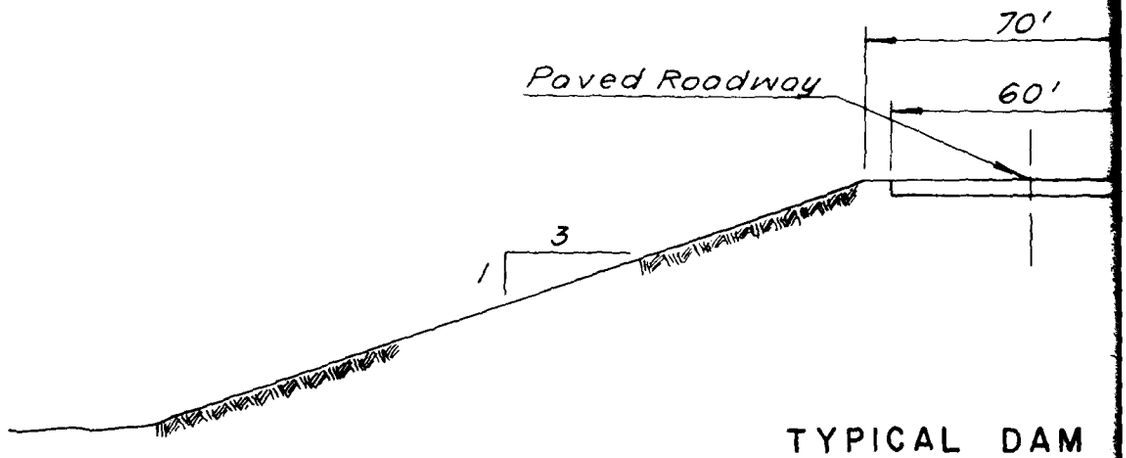
GENERAL PLAN

CUMBERLAND POND DAM

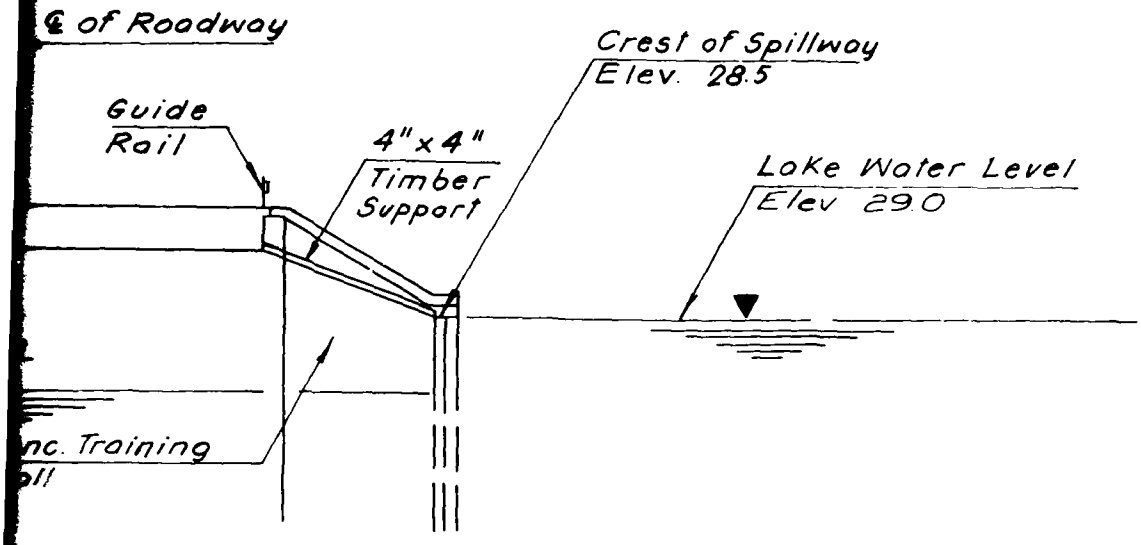
I.D. N.J. 00824	SCALE NOT TO SCALE
	DATE FEB 98



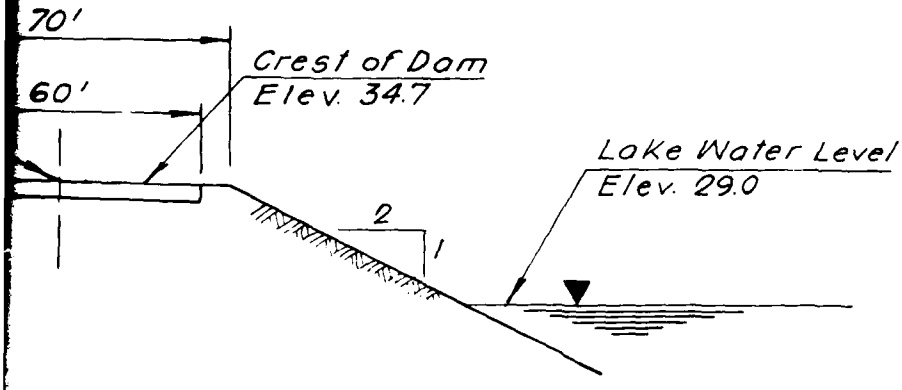
SPILLWAY SEC



TYPICAL DAM



SECTION



DAM SECTION

PLATE 5

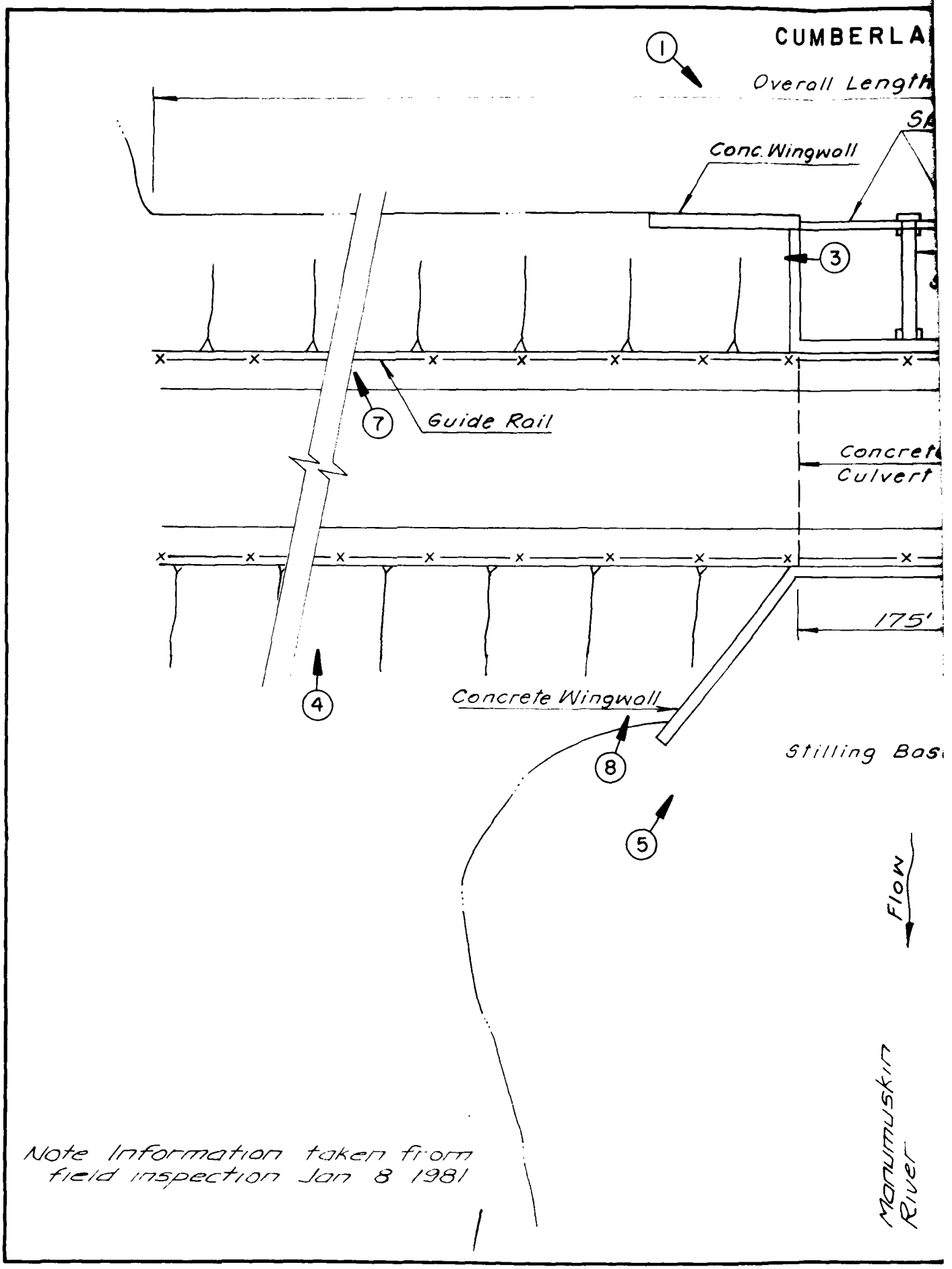
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

SECTIONS

CUMBERLAND POND DAM

I.D. N.J. 00824	SCALE: NOT TO SCALE
	DATE: FEB. 1981


CUMBERLA
1
Overall Length
SA
Conc. Wingwall
3
7
Guide Rail
Concrete
Culvert
175'
4
Concrete Wingwall
8
Stilling Bas
5
Flow
Manumuskin
River
Note Information taken from
field inspection Jan 8 1981

RLAND POND

ngth of Dam = 840

OVERVIEW

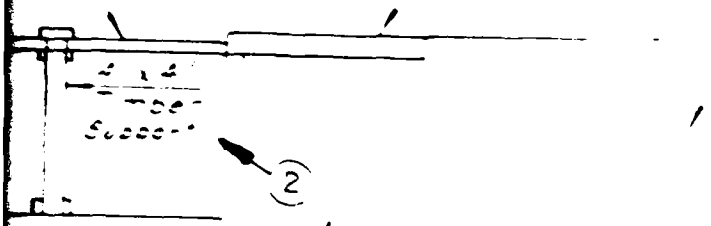


PLATE 6

...W ENGINEERS	DIVISION OF WATER RESOURCES NJ DEPT OF ENVIR PROTECTION

INSPECTION AND EVALUATION OF DAMS

PHOTO LOCATION PLAN

CUMBERLAND POND DAM

APPENDIX 1

Check List - Visual Inspection

Check List - Engineering Data

Check List

Visual Inspection

Phase I

Name of Dam Cumberland Pond County Cumberland State N.J. Coordinators NJDEP

Date(s) Inspection 1/8/81 Weather Sunny Temperature 10°F

Pool Elevation at time of Inspection 29.0 M.S.L. Tailwater at Time of Inspection 26.2 M.S.L.

Inspection Personnel:

John Gribbin
John Powanda
Daniel Buckelew
Richard McDermott
Mark Brady

John Gribbin Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	Paved highway on crest (Rt. 49) in satisfactory condition. Grass, bushes, and trees (2"-18") on downstream face. Grass, bushes and trees (2") on upstream face. Timber and cable guide rail on crest in satisfactory condition.	All trees and adverse vegetation should be removed. Embankment obscured by snow.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Junctions appeared to be stable. Some surface erosion observed --See Erosion	
ANY NOTICEABLE SEEPAGE	None observed	
STAFF GAGE AND RECORDER	Staff gage observed in stilling basin adjacent to the right downstream wingwall. Water level on staff gage read 2.8 at time of inspection.	
DRAINS	None observed	

EMBANKMENT

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Upstream face generally uniform with some erosion observed along upstream face and adjacent to bridge wingwalls.	Erosion of embankment should be properly filled and stabilized.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Vertical: generally level Horizontal: straight	
RIPRAP	None observed	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SURFACES IN OUTLET CONDUIT	Outlet works discharge through spillway	Outlet works comprised of timber stoplogs in spillway structure
INTAKE STRUCTURE	N/A	
OUTLET STRUCTURE	N/A	
OUTLET CHANNEL	Outlet works discharges into spillway discharge channel.	
GATE AND GATE HOUSING	Gate consists of timber stoplogs. Condition of stoplogs could not be properly assessed due to overflow.	

SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
WEIR	Condition of timber stoplogs could not be properly assessed due to presence of discharge. However, stoplog structure appeared sound.	
INTAKE CHANNEL	Not available	
DISCHARGE CHANNEL	Concrete surfaces of wingwalls and headwalls appeared to be satisfactory. Patched vertical crack observed in center of left downstream wingwall.	Discharge channel formed by concrete bridge, abutments, and wingwalls. Entire structure appeared to be stable.
BRIDGE	Bridge deck appeared to be in satisfactory condition	Under side of deck not observed.

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	Staff gage (See Embankment)	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Reservoir surrounded by wooded area with shore banks approx. 2' high with flat slopes beyond less than 1%	
SEDIMENTATION	Unknown	
STRUCTURES ALONG BANKS	One building located near the upstream end of the reservoir.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTION, DEBRIS, ETC.)	Stilling basin about 3' deep lined with trees located immediately downstream of dam. Channel beyond stilling basin sluggish meandering natural stream. No debris observed.	
SLOPES	Banks approx. 2' high with a gentle sloping floodplain of approx. 2%.	
STRUCTURES ALONG BANKS	Four dwellings along left bank located between 100' and 600' downstream from the dam approx. 5' above stream bed.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM			REMARKS
DAM	-	PLAN	Plan on file with N.J.D.O.T. (File #0606-151) entitled "Route No. 47, Sec 2, Sta 255+41", dated 5/7/29
		SECTIONS	
SPILLWAY	-	PLAN	On file with N.J.D.O.T.
		SECTIONS	
		DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS			Not available
OUTLETS	-	PLAN	On file with N.J.D.O.T.
		DETAILS	
		CONSTRAINTS	
		DISCHARGE RATINGS	
HYDRAULIC/HYDROLOGIC DATA			Not available
RAINFALL/RESERVOIR RECORDS			Not available
CONSTRUCTION HISTORY			Not available
LOCATION MAP			On file with N.J.D.O.T.

ITEM	REMARKS
DESIGN REPORTS	Not available
GEOLOGY REPORTS	Not available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM INSTABILITY SEEPAGE STUDIES	Not available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Not available
POST-CONSTRUCTION SURVEYS OF DAM	Not available
BORROW SOURCES	Not available

ITEM	REMARKS
MONITORING SYSTEMS	Not available
MODIFICATIONS	Not available
HIGH POOL RECORDS	Not available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Not available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Not available
MAINTENANCE OPERATION RECORDS	Not available

APPENDIX 2

Photographs

PHOTO 1

UPSTREAM VIEW OF SPILLWAY

PHOTO 2

CREST OF SPILLWAY

CUMBERLAND POND DAM
8 JANUARY 1981

PHOTO 3

UPSTREAM FACE OF DAM NEAR SPILLWAY

PHOTO 4

DOWNSTREAM FACE OF DAM

CUMBERLAND POND DAM

8 JANUARY 1981

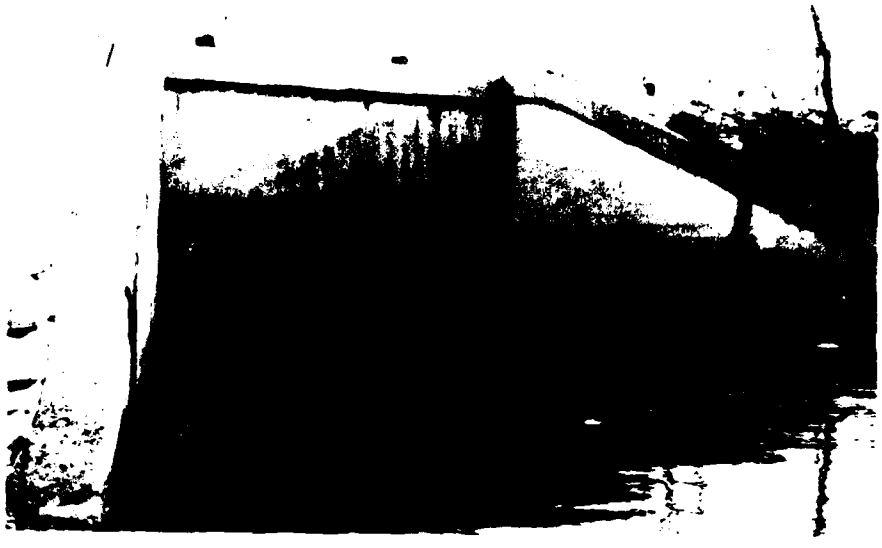


PHOTO 5

DOWNSTREAM END OF BRIDGE

PHOTO 6

STILLING BASIN WITH GRADUATED STAFF
GAGE NEAR DOWNSTREAM END OF RIGHT WINGWALL

CUMBERLAND POND DAM
8 JANUARY 1981

PHOTO 7

EROSION ON UPSTREAM FACE OF DAM

PHOTO 8

EROSION ON DOWNSTREAM FACE OF DAM
ADJACENT TO BRIDGE

CUMBERLAND POND DAM
8 JANUARY 1981

APPENDIX 3

Engineering Data

CHECK LIST

HYDROLOGIC AND HYDRAULIC DATA

ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Wooded and swampy

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 29.0 (57 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: 35.2

ELEVATION TOP DAM: 34.7

SPILLWAY CREST: Controlled Weir - Stoplogs

a. Elevation 28.5

b. Type Sharp-Crested Weir

c. Width 0.2 feet

d. Length 17.5 feet

e. Location Spillover Upstream side of dam

f. Number and Type of Gates One set of stoplogs

OUTLET WORKS: Included in Spillway

a. Type Removable Timber Stoplogs

b. Location Upstream side of dam

c. Entrance Invert 26.0

d. Exit Invert 26.0

e. Emergency Draindown Facilities: Remove stoplogs

HYDOMETEOROLOGICAL GAGES:

a. Type Graduated Staff Gage

b. Location Downstream right bridge wingwall

c. Records None available

MAXIMUM NON-DAMAGING DISCHARGE:

(Lake Stage Equal to Top of Dam) 896 c.f.s.

APPENDIX 4

Hydraulic/Hydrologic Computations

HYDROLOGY:

HYDROLOGIC ANALYSIS - RUNOFF HYDROGRAPH FOR CUMBERLAND POND DAM WILL BE DEVELOPED BY HEC-1-DAM COMPUTER PROGRAM USING THE SNYDERS SYNTHETIC UNIT HYDROGRAPH

DRAINAGE AREA = 27.9 Square miles

INFILTRATION DATA

DRAINAGE AREA IS WOODED

INITIAL INFILTRATION = 1.5 inches
CONSTANT INFILTRATION = 0.15 inches/hour

SNYDER'S STANDARD LAG

['Introduction to hydrology' Pg 135]

$t_p = C_t (L L_{CA})^{0.3}$

$t_p = 7.5 (7.95 \times 4.8)^{0.3}$

$t_p = 22.4$ [Hr]

t_p = Snyders Standard Lag time [Hr]

C_t = coefficient for slopes & storage

L = length of main channel [Mi]

L_{CA} = length along the main channel to the watersheid centroid [Mi]

$C_t = 7.5$ (supplied by Corps of Engineers)

COMPUTER INPUT

SNYDERS STANDARD
LAG TIME = 22.4 Hr.

$C_p = 0.23$ (Supplied by Corps of Engineers)

PRECIPITATION :

[U.S.D.C. Rep. 40 pg. 57]

Probable maximum precipitation = 27 inches for 6 hours duration and 10 Sq mi area

Percentage of PMP for 27.9 Sq mi :

Duration [hr]	% PMP
6	92
12	99
24	108

STORAGE VOLUME

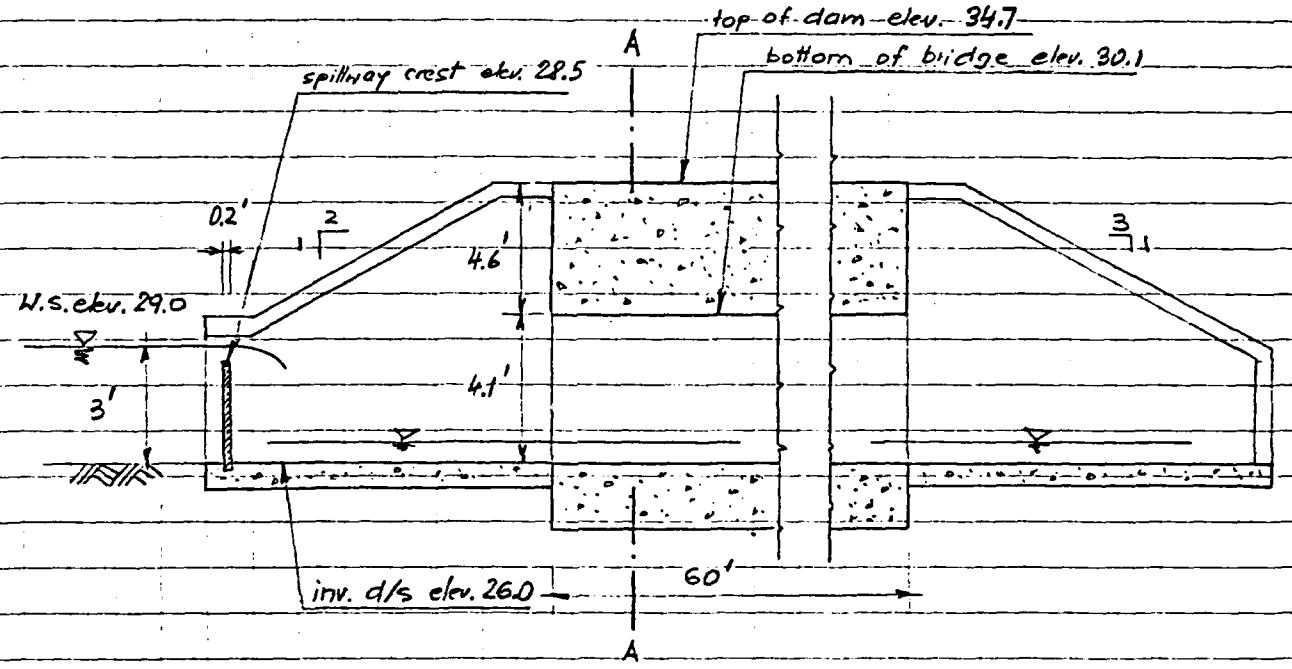
W.S. ELEV. [Ft]	AREA [Acres]
22.5	0
29.0	26.35
30.0	62
40.0	415

HEC-1-DAM PROGRAM WILL DEVELOP STORAGE CAPACITY FROM SURFACE AREAS & ELEVATIONS

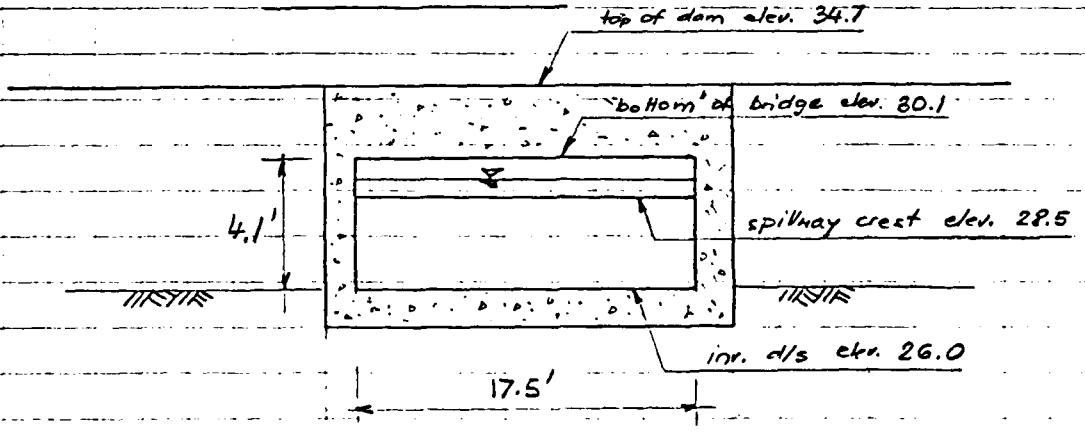
INFORMATION TAKEN FROM U.S.G.S FIVE POINTS, PORT ELIZABETH & DOROTHY QUADRANGLE, N.J.

HYDRAULICS

THE SPILLWAY AT CUMBERLAND POND DAM IS A FREE OVERFLOW SHARP CRESTED WEIR AT ELEV. 28.5 FEET WITH AN EFF. LENGTH OF 17.5 FEET.



SECTION A-A



DISCHARGE [Handbook of hydraulics: Pg 5-3]

DISCHARGE WILL BE CALCULATED USING WEIR FORMULA :

$$Q = C L H^{3/2}$$

Q = discharge [cfs]
C = coefficient of discharge
L = effective length of spillway being overtoped [Ft]
H = head total on spillway [Ft]

SPILLWAY

STAGE DISCHARGE TABULATION:

[SHC - 5-31]

	WEIR		
W.S.	L = 17.5'		
elevation	H	C	Q
[Ft]	[Ft]		[cfs]
28.5	—	—	0
29.0	0.5	3.0	18.0
29.5	1.0	3.32	58.0
30.0	1.5	3.32	106.0
31.0	2.5	3.32	229.0
32.0	3.5	3.32	380.0
33.0	4.5	3.32	554.0
34.0	5.5	3.32	749.0
34.7	6.2	3.32	896.0
35.0	6.5	3.32	962.0
36.0	7.5	3.32	1193.0
37.0	8.5	3.32	1439.0
38.0	9.5	3.32	1701.0
39.0	10.5	3.32	1977.0
40.0	11.5	3.32	2266.0

Discharge outlet control for concrete box culvert
17.5' x 4.1'
Length 60.0'

[nomograph chart 8]:

HW = 7.0' ke = 0.05
dc = 4.2'
W.S. EL. = 33.0
Q = 850.0 cfs

HW = 8.7' ke = 0.05
dc = 4.6'
(top of dam) W.S.EL. = 34.7

Q_{Top} = 970.0 cfs

STORCH ENGINEERS

Sheet 7 of 12

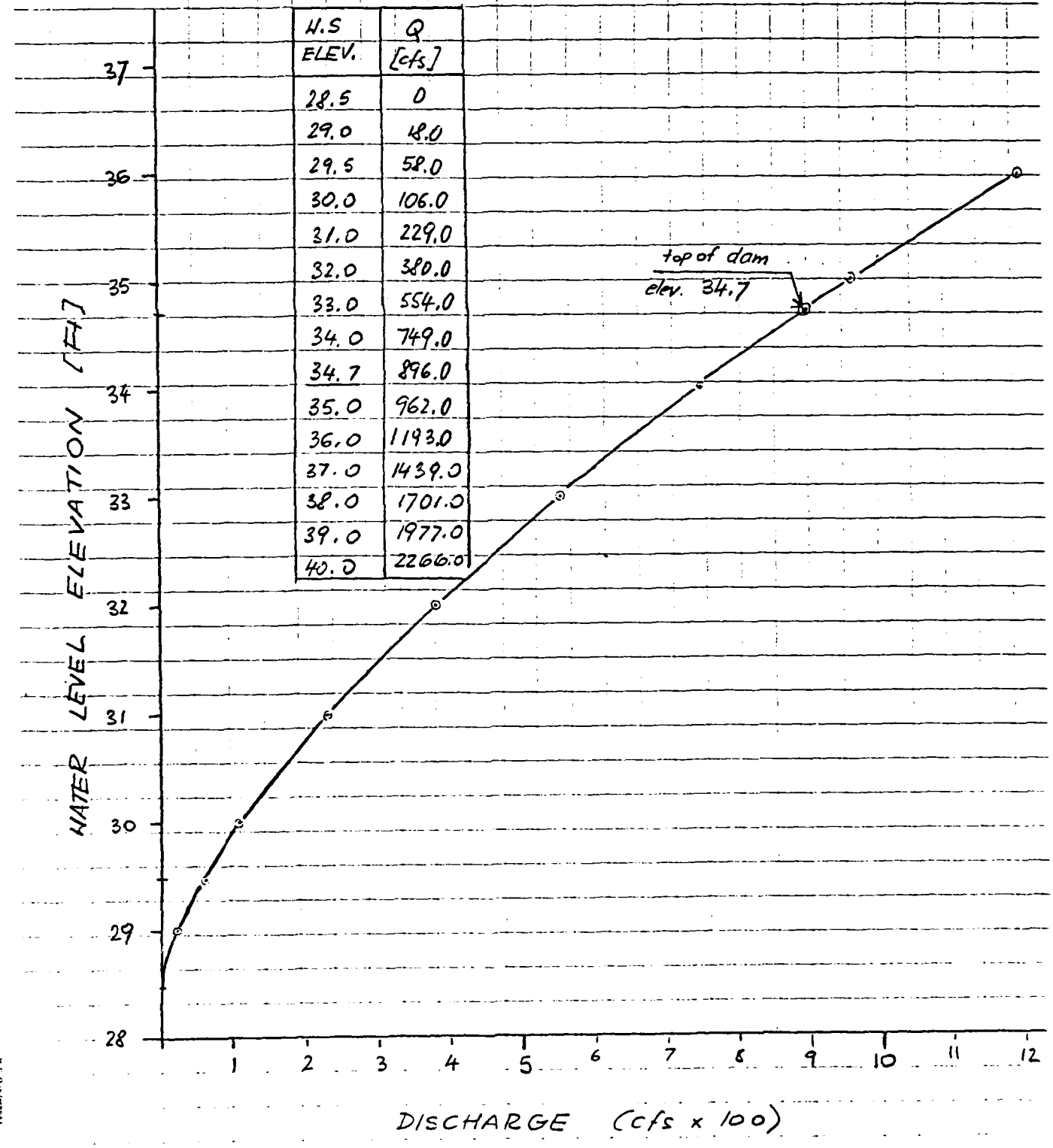
Project 1132-06 CUMBERLAND POND DAM Made By J.HG Date 3-11-81

Chkd By JG Date 3/24/81

SPILLWAY

STAGE DISCHARGE CURVE

W.S ELEV.	Q [cfs]
28.5	0
29.0	48.0
29.5	58.0
30.0	106.0
31.0	229.0
32.0	380.0
33.0	554.0
34.0	749.0
34.7	896.0
35.0	962.0
36.0	1193.0
37.0	1439.0
38.0	1701.0
39.0	1977.0
40.0	2266.0



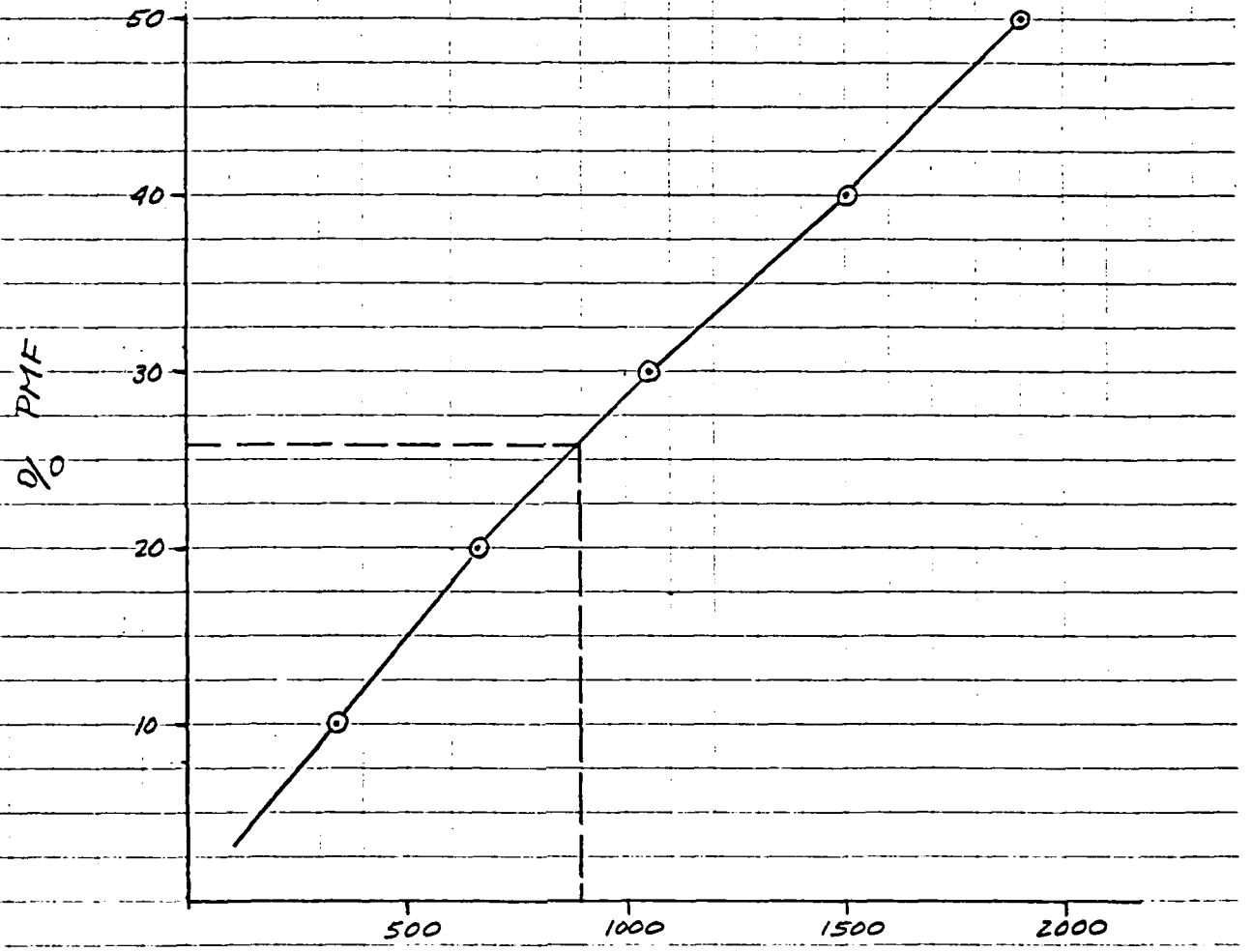
STORCH ENGINEERS

Sheet 8 of 12

Project 1132-06 CUMBERLAND POND DAM Made By JiHa Date 3-11-81

Chkd By JG Date 3/24/81

OVERTOPPING POTENTIAL



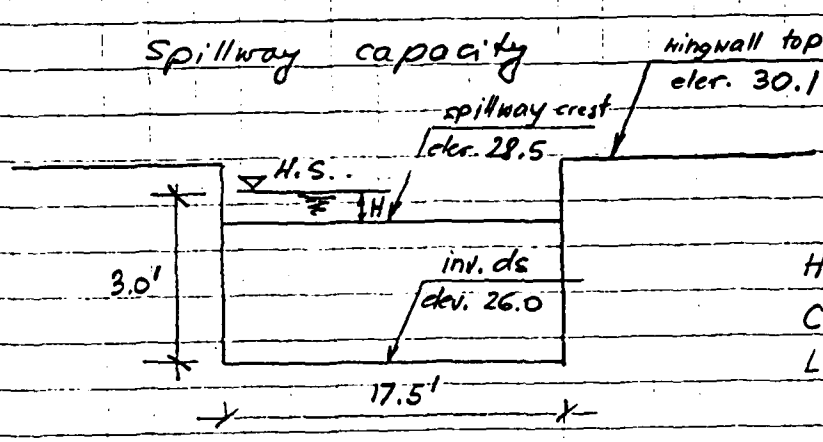
OVERTOPPING OF DAM OCCURS AT ELEV. 34.7

WITH AN OUTFLOW Q = 896.0 cfs

DAM CAN PASS APPROX. 26 % PMF

DRAW DOWN :

Spillway capacity



$H = 1.0'$

$C = 3.32$

$L = 17.5'$

Total drawdown over sharp crested weir

$$Q = C L H^{3/2}$$

$$Q = 3.32 \times 17.5 \times 1.0^{1.5}$$

$$Q = 58 \text{ cfs}$$

TIME OF DRAWDOWN

$$Td = \frac{\text{Storage [Acft]}}{\text{Ave. discharge} - \text{Inflow [cfs]}} \times \frac{43.560}{3600}$$

Assume inflow : 18.0 [cfs]

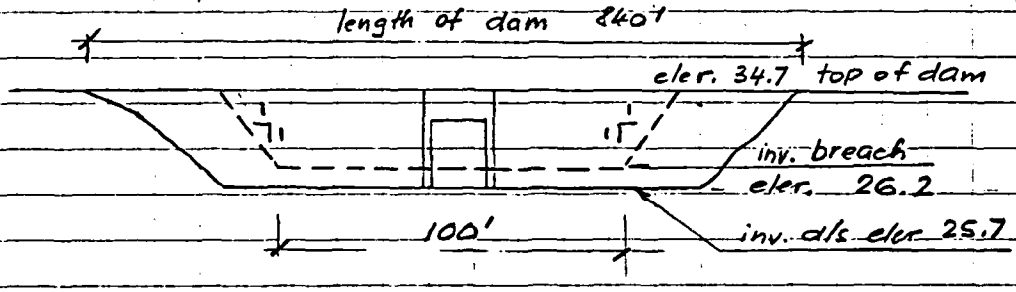
$$Td = \frac{57}{58 - 18.0} \times \frac{43.560}{3600}$$

$$Td = 17 \text{ Hr.}$$

BREACH ANALYSIS:

A BREACH HYDROGRAPH WILL BE COMPUTED BY THE HEC-1-DAM PROGRAM AND ROUTED THROUGH ONE DOWNSTREAM REACH BY THE MODIFIED PLUS METHOD. THE ASSUMED BREACH CONDITIONS ARE AS FOLLOWS:

1. BREACH SECTION



Bottom of breach	elev.	26.2	[Ft]
	effect. length	100	[Ft]
side slope of breach		1:1	
Water surface	elev.	29.0	[Ft]
Water surface elev. which will cause dam to fail	elev	34.7	[Ft]
Time to develop breach to max. size		2.0	[Hr]

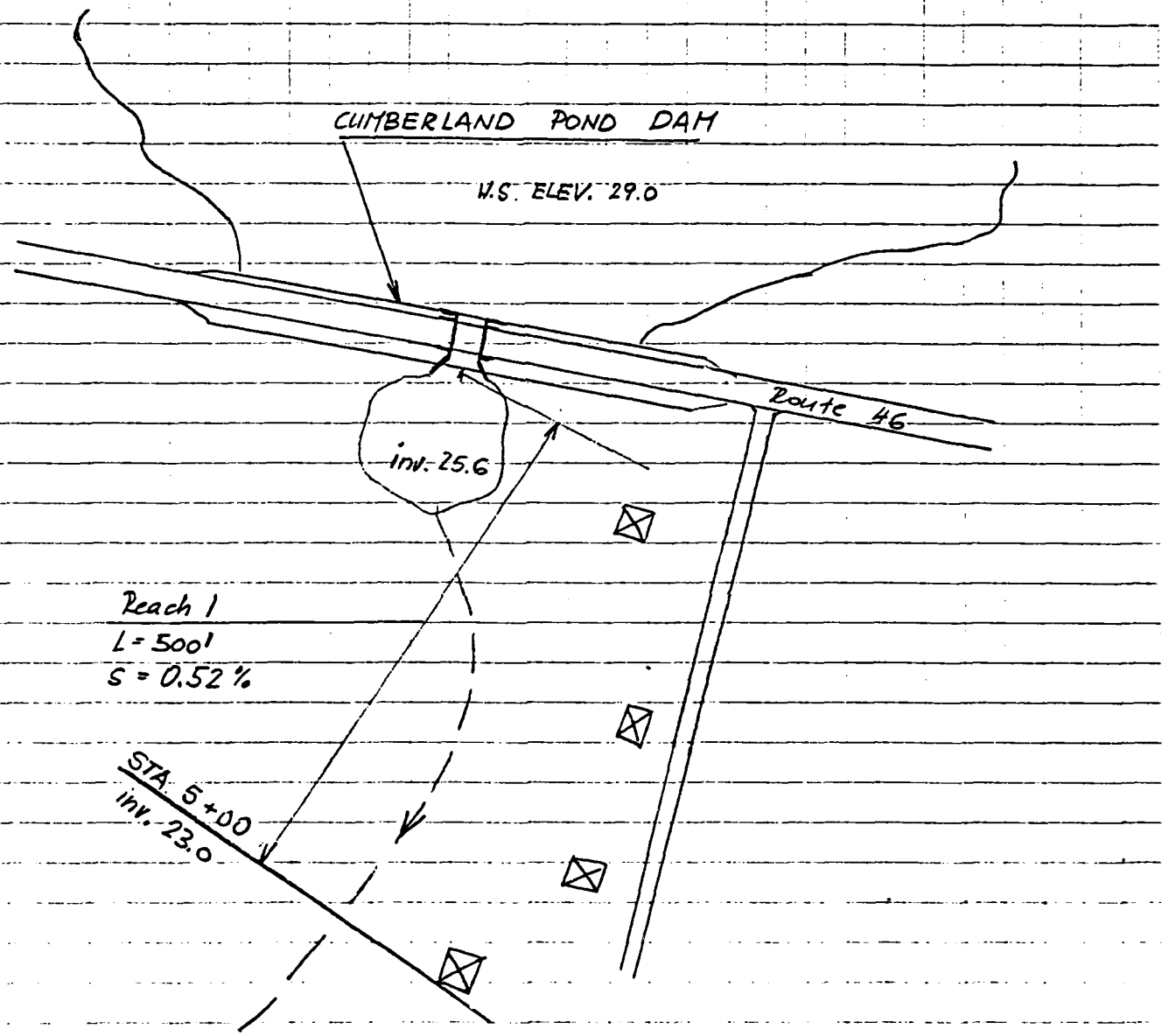
STORCH ENGINEERS

Sheet 11 of 12

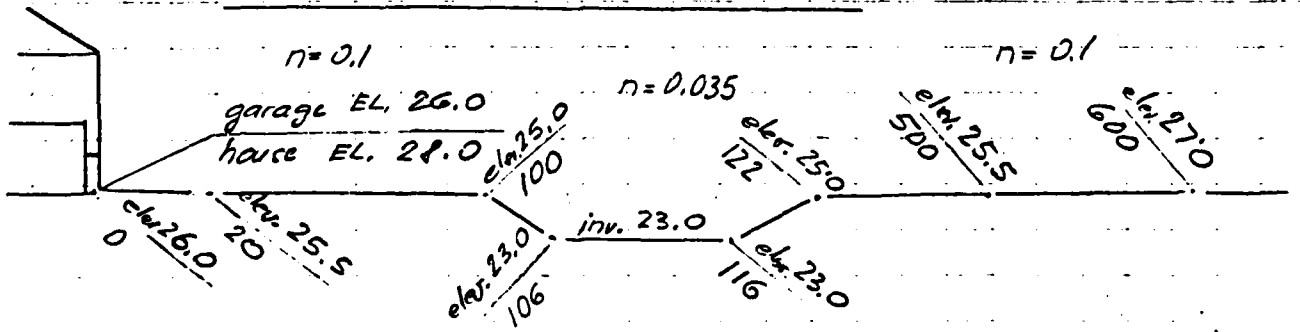
Project 1132-06 CUMBERLAND POND DAM Made By Jitta Date 3-3-81

Chkd By JG Date 3/24/81

DOWNSTREAM CHANNEL



TYPICAL CROSS SECTION



BREACH RESULTS:

1. PEAK OUTFLOW = 6245 [cfs]

2. Max. CHANNEL STAGE:

REACH 1 inv. elev. = 23.0 [Ft]
max. stage elev. = 28.1 [Ft]

Dwellings inundated by 2.1 ft above gar. floor and 0.1 ft above first floor.

HEC - 1 - DAM PRINTOUT

Overtopping Analysis

```
1A1                          NATIONAL DAM SAFETY PROGRAM
 A2                          CUMBERLAND POND DAM , NEW JERSEY
 A3                          MULTI-RATIO ROUTING
 B     100       3       0                                                  4
 B1      5
 J       1       5       1
 J1    0.5     0.4     0.3     0.2     0.1
 K       0    LAKE                                    1
 K1                          INFLOW HYDROGRAPH TO CUMBERLAND POND DAM
 M       1       1    27.9            27.9                                  1
 P              27.0      92      99     108
 T                                                    1.5    0.15
 W    22.4    0.23
 X    -1.0   -0.05     2.0
 K       1     DAM
 K1                          ROUTE DISCHARGE THROUGH DAM
 Y                                       1       1
 Y1      1                                                  -29.0      -1
 Y4   28.5    29.0    29.5    30.0    31.0    32.0    33.0    34.0    34.7    35.0
 Y4   36.0    37.0    38.0    39.0    40.0
 Y5      0      18      58     106     229     380     554     749     896     962
 Y5   1193    1439    1701    1977    2266
 $A      0   26.35      62     415
 $E   22.5    29.0    30.0    40.0
 $$   28.5
 $D   34.7     2.7     1.5     822
 K       1       1                                       1
 K1                          CHANNEL ROUTING REACH 1
 Y                                       1       1
 Y1      1
 Y6    0.1   0.040     0.1    23.0    27.0     500   0.005
 Y7      0    26.0      20    25.5     100    25.0     104    23.0     116    23.0
 Y7    122    25.0     500    25.5     600    27.0
 K      99
```

NATIONAL DAM SAFETY PROGRAM
CUMBERLAND POND DAM , NEW JERSEY
MULTI RATIO ROUTING

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	3	0	0	0	0	0	0	4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1

RTIOS= .50 .40 .30 .20 .10

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH TO CUMBERLAND POND DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LAKE	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	27.90	0.00	27.90	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	27.00	92.00	99.00	108.00	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .833

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.50	.15	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 22.40 CP= .23 NTA= 0

RECESSION DATA
STRTQ= -1.00 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 22.50 HOURS, CP= .23 VOL= .97

8.	29.	60.	97.	134.	163.	182.	187.	181.	175.
169.	163.	157.	152.	146.	141.	136.	131.	127.	122.
118.	114.	110.	106.	102.	98.	95.	92.	88.	85.
82.	79.	77.	74.	71.	69.	66.	64.	62.	60.
57.	55.	53.	52.	50.	48.	46.	45.	43.	42.
40.	39.	37.	36.	35.	33.	32.	31.	30.	29.
28.	27.	26.	25.	24.	23.	23.	22.	21.	20.
20.	19.	18.	18.	17.	16.	16.	15.	15.	14.
14.	13.	13.	12.	12.	11.	11.	11.	10.	10.
10.	9.	9.	9.	8.	8.	8.	7.	7.	7.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	24.30	20.49	3.01	118740.
										(617.)(520.)(77.)(3248.34)			

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE DISCHARGE THROUGH DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	0	0	0	0	0	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-29.	-1

STAGE	28.50	29.00	29.50	30.00	31.00	32.00	33.00	34.00	34.70	35.00
	36.00	37.00	38.00	39.00	40.00					
FLOW	0.00	18.00	58.00	106.00	229.00	380.00	554.00	749.00	896.00	962.00
	1193.00	1439.00	1701.00	1977.00	2266.00					
SURFACE AREA=	0.	26.	62.	415.						
CAPACITY=	0.	57.	100.	2225.						
ELEVATION=	23.	29.	30.	40.						

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
28.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
34.7	2.7	1.5	822.

PEAK OUTFLOW IS 1918. AT TIME 36.00 HOURS

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .50	RATIO 2 .40	RATIO 3 .30	RATIO 4 .20	RATIO 5 .10
HYDROGRAPH AT	LAKE	27.90	1	1899.	1519.	1139.	760.	380.
		(72.26)		(53.77)	(43.02)	(32.26)	(21.51)	(10.75)
ROUTED TO	DAM	27.90	1	1918.	1559.	1071.	669.	342.
		(72.26)		(54.32)	(44.16)	(30.34)	(18.96)	(9.67)
ROUTED TO	1	27.90	1	1917.	1555.	1070.	671.	342.
		(72.26)		(54.28)	(44.02)	(30.31)	(18.99)	(9.68)

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	29.00	28.50	34.70
STORAGE	57.	45.	663.
OUTFLOW	18.	0.	896.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	35.25	.55	772.	1918.	75.00	36.00	0.00
.40	35.11	.41	742.	1559.	51.00	39.00	0.00
.30	34.86	.16	693.	1071.	21.00	45.00	0.00
.20	33.59	0.00	474.	669.	0.00	51.00	0.00
.10	31.75	0.00	241.	342.	0.00	48.00	0.00

PLAN 1 STATION 1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	1917.	27.1	39.00
.40	1555.	26.9	39.00
.30	1070.	26.5	45.00
.20	671.	26.1	51.00
.10	342.	25.7	51.00

HEC - 1 - DAM PRINTOUT

Breach Analysis

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1A1                        NATIONAL DAM SAFETY PROGRAM
A2                         CUMBERLAND POND DAM , NEW JERSEY
A3                         MULTI RATIO ROUTING
B     100        3         0                                                    4
B1      5
J       1        5         1
J1    0.5      0.4       0.3       0.2       0.1
K       0     LAKE                                                  1
K1                         INFLOW HYDROGRAPH TO CUMBERLAND POND DAM
M       1        1      27.9                 27.9                             1
P               27.0        92        99       108
T                                                                  1.5      0.15
W    22.4     0.23
X    -1.0    -0.05       2.0
K       1      DAM
K1                         ROUTE DISCHARGE THROUGH DAM
Y                                       1         1
Y1      1                                                        -29.0       -1
Y4   28.5     29.0       29.5      30.0      31.0      32.0      33.0      34.0     34.7     35.0
Y4   36.0     37.0       38.0      39.0      40.0
Y5      0       18         58       106       229       380       554       749      896      962
Y5   1193     1439       1701      1977      2266
$A      0    26.35         62       415
$E   22.5     29.0       30.0      40.0
$$   28.5
$D   34.7      2.7        1.5       822
$B    100        1         26.2      2.0       29.0      34.7
K       1        1                                                  1
K1                         CHANNEL ROUTING REACH 1
Y                                       1         1
Y1      1
Y6    0.1    0.040        0.1      23.0      27.0       500     0.005
Y7      0     26.0         20      25.5       100      25.0       106      23.0      116      23.0
Y7    122     25.0        500      25.5       600      27.0
K      99
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                    NATIONAL DAM SAFETY PROGRAM
                    CUMBERLAND POND DAM , NEW JERSEY
                    MULTI RATIO ROUTING

                          JOB SPECIFICATION
   NO     NHR    NMIN    IDAY    IHR    IMIN   METRC    IPLT    IPRT   NSTAN
  100       3       0       0      0       0       0       0       4       0
                        JOPER    NWT   LROPT   TRACE
                            5      0       0       0

                 MULTI-PLAN ANALYSES TO BE PERFORMED
                    NPLAN= 1 NRTIO= 5 LRTIO= 1
          RTIOS=    .50    .40    .30    .20    .10


 **********    **********    **********    **********    **********

                      SUB-AREA RUNOFF COMPUTATION

                 INFLOW HYDROGRAPH TO CUMBERLAND POND DAM

            ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
             LAKE       0       0       0       0       0       1       0       0

                              HYDROGRAPH DATA
   IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
       1       1   27.90    0.00   27.90    0.00   0.000       0       1       0

                                PRECIP DATA
              SPFE     PMS      R6     R12     R24     R48     R72     R96
              0.00   27.00   92.00   99.00  108.00    0.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS  .833

                                LOSS DATA
    LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
        0    0.00    0.00    1.00    0.00    0.00    1.00    1.50     .15    0.00    0.00

                            UNIT HYDROGRAPH DATA
                       TP= 22.40    CP= .23    NTA=  0

                               RECESSION DATA
                   STRTQ=   -1.00    QRCSN=   -.05    RTIOR= 2.00

       UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG=  22.50 HOURS, CP=  .23  VOL=  .97
          8.      29.      60.      97.     134.     163.     182.     187.     181.     175.
        169.     163.     157.     152.     146.     141.     136.     131.     127.     122.
        118.     114.     110.     106.     102.      98.      95.      92.      88.      85.
         82.      79.      77.      74.      71.      69.      66.      64.      62.      60.
         57.      55.      53.      52.      50.      48.      46.      45.      43.      42.
         40.      39.      37.      36.      35.      33.      32.      31.      30.      29.
         28.      27.      26.      25.      24.      23.      23.      22.      21.      20.
         20.      19.      18.      18.      17.      16.      16.      15.      15.      14.
         14.      13.      13.      12.      12.      11.      11.      11.      10.      10.
         10.       9.       9.       9.       8.       8.       8.       7.       7.       7.

   0                              END-OF-PERIOD FLOW
   MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q    MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q

                                                          SUM  24.30  20.49   3.81  118740.
                                                              ( 617.)( 520.)(  97.)( 3362.34)
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HYDROGRAPH ROUTING

ROUTE DISCHARGE THROUGH DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	0	0	0	0	0	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-29.	-1

STAGE	28.50	29.00	29.50	30.00	31.00	32.00	33.00	34.00	34.70	35.00
	36.00	37.00	38.00	39.00	40.00					
FLOW	0.00	18.00	58.00	106.00	229.00	380.00	554.00	749.00	896.00	962.00
	1193.00	1439.00	1701.00	1977.00	2266.00					
SURFACE AREA=	0.	26.	62.	415.						
CAPACITY=	0.	57.	100.	2225.						
ELEVATION=	23.	29.	30.	40.						

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
28.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
34.7	2.7	1.5	822.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
100.	1.00	26.20	2.00	29.00	34.70

BEGIN DAM FAILURE AT 33.00 HOURS

PEAK OUTFLOW IS 6245. AT TIME 35.00 HOURS

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .50	RATIO 2 .40	RATIO 3 .30	RATIO 4 .20	RATIO 5 .10
HYDROGRAPH AT	LAKE	27.90	1	1899.	1519.	1139.	760.	380.
		(72.26)	(	53.77)(	43.02)(	32.26)(	21.51)(	10.75)(
ROUTED TO	DAM	27.90	1	3346.	2964.	2399.	669.	342.
		(72.26)	(	94.76)(	83.94)(	67.92)(	18.96)(	9.67)(
ROUTED TO	1	27.90	1	3263.	2908.	2347.	671.	342.
		(72.26)	(	92.39)(	82.34)(	66.47)(	18.99)(	9.68)(

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	29.00	28.50	34.70
STORAGE	57.	45.	663.
OUTFLOW	18.	0.	896.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	34.90	.20	701.	6245.	3.92	35.00	33.00
.40	34.88	.18	697.	5974.	3.80	38.00	36.00
.30	34.76	.06	673.	5487.	3.48	44.00	42.00
.20	33.59	0.00	474.	669.	0.00	51.00	0.00
.10	31.75	0.00	241.	342.	0.00	48.00	0.00

PLAN 1 STATION 1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	3263.	28.1	36.00
.40	2908.	27.8	39.00
.30	2347.	27.4	45.00
.20	671.	26.1	51.00
.10	342.	25.7	51.00

APPENDIX 5

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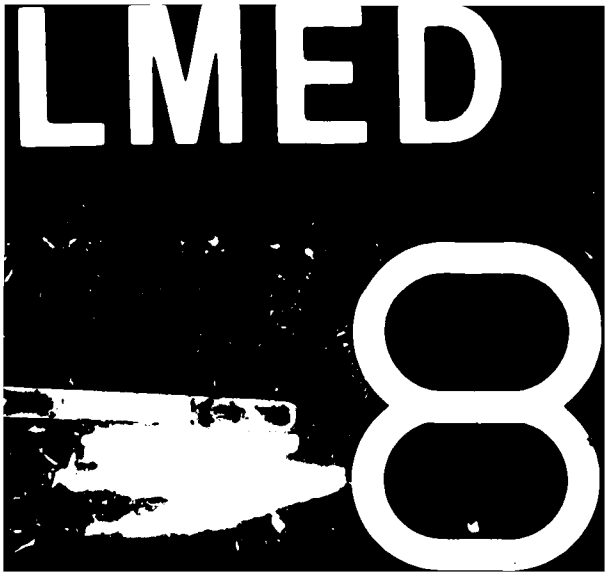
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